

## A BIBLIOMETRIC REVIEW OF CHATBOTS IN THE CONTEXT OF CUSTOMER SUPPORT

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**Abstract:** *With the birth of new technologies and their progressive incorporation into everyday life, human beings have managed to perform tasks much more efficiently than previously required a large number of personnel and time. Nowadays, these tasks, which could be a significant added burden for companies, are considerably reduced thanks to technology and Artificial Intelligence (AI). It is clear that technological globalization is present on a daily basis and is increasingly incorporated progressively in almost all known sectors. These rapid technological advances have allowed the development of various tools that facilitate some of the tasks of different companies, one of which is the Chatbots. This article identifies the important issues on which scholars have focused, and so can serve as a reference for the future research and discussions of chatbots. The first goal we set was to understand what a chatbot is and how they work. The second objective was to know their characteristics, advantages and disadvantages.*

**Keywords:** *chatbot, bibliometrics analysis, Scopus, VOSviewer, customer service, conversational agents,*

### INTRODUCTION

This paper presents the results of a study combining bibliometric analysis and extensive literature review with the aim of discussing about chatbots, about their relationship with artificial intelligence (AI) and how chatbots emerged in client-supplier interaction. The paper focuses on two main objectives of the study, namely: (1) to understand what the chatbots are and how they work, and (2) to shed a light on chatbots' characteristics and the benefits they bring. It can be said that Chatbots, in the first instance, need a human to enter a series of commands and values on which the machine can start working. From there and after a lot of programming work, "Technological Independence" is achieved, that is, the machine is able to understand, process and evolve with the new information that arrives. This part is essential and will act as a separating filter between a good and a bad AI. Therefore, creating chatbots for companies can involve various problems. The first and most widespread is the lack of knowledge of the process of creation and implementation of this tool. Then, if benefits are obtained with this project and if it compensates to replace human labor. While it is true that AI replaces part of the work that a human would do, a person is needed to "teach" it during its creation so that in the future they can work in an automated way.

A variety of terms are used to refer to these applications such as *chatterbots*, virtual assistants, virtual agents, intelligent agents, conversational bots, conversational interfaces or web-bots. Chatbot technology integrates a language model and computational algorithms to emulate informal chat communication between a human user and a computer

using natural language. Users can chat via text or voice input on the computer or mobile device screen with the text or audio/voice output of the chatbot (Wang & Petrina, 2013). "ChatBots" are computer programs that, through the use of a series of algorithms (which are applied by making software), obtaining a series of data and, sometimes, using Artificial Intelligence, are able to simulate human conversations and solve the doubts of users. "Chatbot is a program that has the ability to hold a conversation with humans using *Natural Language Processing*." (Abdul-Kader & John, 2015). Currently, *chatbots* are one of the most promising technologies, as many companies are making use of them in *customer support*.

A chatbot is defined as an intelligent software program that communicates with its user in natural language through chat and can be used for commercial purposes (Milan Van Eeuwen, 2017). In addition, another of the authors defines it as a computer program that imitates human conversation in its natural format, including text or spoken language, using artificial intelligence techniques such as "Natural Language Processing" (NLP). In recent years, Chatbots have become considerably popular due to their dominance and immediacy when it comes to answering users' questions and doubts, in addition to their total daily availability 365 days a year. This makes the user experience increasingly promising, and therefore the application of this software in turn is more demanded by companies to improve their marketing strategy and customer service.

### **Objectives and methodology**

The objectives of this study are as follows:

- Understand what a chatbot is and how they work.
- Know their characteristics, the benefits they bring.

We performed a literature review combined with a bibliometric analysis. Bibliometrics emerged a few decades ago to statistically measure the scholarly publications in terms of their extrinsic aspects. Those analyses earlier helped libraries to manage their collections and subscriptions. According to Beck and Manuel (2008) bibliometrics "is one of the oldest research methods in library and information science," and this field of study is now on fast track with the advent of sophisticated computer technology and tools. Wilson (2012) says that "bibliometrics can also be referred to as informetrics, webometrics, scientometrics, and cybermetrics. The different terms basically reflect the types of information to which the analysis is applied." Therefore, these terms, with slightest changes in context or purpose, could represent the same connotation to analyse the metrics of scholarly communications.

First, we searched and collected the articles to be analyzed, which should represent the field of *virtual assistants* in *relational marketing*. The second stage of the method concerns several bibliometric analyses to map the field and identify its most important themes. The search we performed in November 2022, returned 479 articles. Filtering this initial data set out, English articles, excluding several subject areas (Mathematics, Physics and Astronomy, Energy, Arts and Humanities, Medicine, Environmental Science, Materials Science, Earth and Planetary Sciences, Agricultural and Biological Sciences, Pharmacology, Toxicology and Pharmaceuticals, Chemical Engineering), and excluding duplicates, we finally retrieved 318 articles. These articles ranged from 2011 (1 article) to

2022 (84 articles, available in November). The articles were analysed using the VOS Viewer software (van Eck & Waltman, 2010), developed and offered by Leiden University. Scopus database was used for our bibliometric analyses. Using the AND operator, we combined the search string for *chatbot* ("virtual agent\*" OR chatterbox\* OR "virtual agent\*" OR chatbot\* OR chatterbot\* OR chatterbox\*) with that for *relational marketing* ("relationship marketing" OR "relational marketing" OR "customer satisfaction" OR "customer experience" OR "customer care" OR "customer service") in the title, abstract and keywords.

## Results

Bibliometric studies have a range of applications at present. Mabrouk (2015) says that bibliometrics would help bring insights of publication practices, identify influential papers, authors and journals in a domain, and to locate potential collaborators. According to Hoffman and Doucette (2012), citation analysis is a simple methodology that utilizes readily available bibliographic data of references. By doing so researcher is able to understand publication trends within a given discipline, and measure the accuracy of citation indexes.

Table below shows that the article with the most citations is Xu et al.’s (2017), which studies “A new chatbot for customer service on social media”.

**Table 1. Top 20 highly cited Chatbot papers**

Authors	Year	Title	Citations
Xu A.; Liu Z.; Guo Y.; Sinha V.; Akkiraju R.	2017	A new chatbot for customer service on social media	256
Chung M.; Ko E.; Joung H.; Kim S.J.	2020	Chatbot e-service and customer satisfaction regarding luxury brands	197
Hoyer W.D.; Kroschke M.; Schmitt B.; Kraume K.; Shankar V.	2020	Transforming the Customer Experience Through New Technologies	139
Ashfaq M.; Yun J.; Yu S.; Loureiro S.M.C.	2020	I, Chatbot: Modeling the determinants of users’ satisfaction and continuance intention of AI-powered service agents	126
Adam M.; Wessel M.; Benlian A.	2021	AI-based chatbots in customer service and their effects on user compliance	122
Ranoliya B.R.; Raghuwanshi N.; Singh S.	2017	Chatbot for university related FAQs	120
Sheehan B.; Jin H.S.; Gottlieb U.	2020	Customer service chatbots: Anthropomorphism and adoption	101
Nuruzzaman M.; Hussain O.K.	2018	A Survey on Chatbot Implementation in Customer Service Industry through Deep Neural Networks	83
Przegalinska A.; Ciechanowski L.; Stroz A.; Gloor P.; Mazurek G.	2019	In bot we trust: A new methodology of chatbot performance measures	79
Canhoto A.I.; Clear F.	2020	Artificial intelligence and machine learning as business tools: A framework for diagnosing value destruction potential	77
Trivedi J.	2019	Examining the Customer Experience of Using Banking Chatbots and Its Impact on Brand Love: The Moderating Role of Perceived Risk	75



Figure 1 portrays the links between authors who collaborated with other contributors. Meanwhile, various sizes of bubbles in the visualization show the strength of authors in terms of the number of publications during the study period. Weaker contributions are not displayed in the normal view.

### **Chatbots and Artificial Intelligence**

Currently, artificial intelligence (AI) is one of the most important components used by companies in developed countries and that, little by little, is permeating the structures of developing countries. The first ideas about AI appeared during the second half of the twentieth century when, from science fiction, it was believed that in the near future there would be anthropomorphic robots that could perform all the activities performed by humans. The reality is that today the situation is somewhat divergent from what was thought in those years. For example, robots that have been designed and thrive on AI can far exceed the capabilities of humans in technical matters such as mathematics or chess; however, they are limited to specific and monotonous activities (Lu, Li, Chen, Kim and Serikawa, 2018). For context, it's important to talk about what artificial intelligence means. This is defined differently in different contexts, so it is valuable to conceptualize it in terms of marketing. One of the recent descriptions we have, defines it as a collection of advanced technologies that allows machines to feel, understand, act and learn (Daugherty et al., 2018), and as a sophisticated application of technology by which a machine demonstrates human cognitive functions such as learning, analysis and problem solving (Valin, 2018). In addition, it is important to mention that, according to many experts, the use of computerized machinery to emulate capabilities that were once unique to humans is expected to have an even greater impact on business than social networks.

At present, AI does not have a single and accepted definition, since, being a complex, new and changing science, providing an exact definition of it is almost impossible (Pascual, 2019). This science covers a wide range of fields of research in which you can find various definitions of authors brought to their branch of study. Within the realm of computing, the concept of AI was proposed by McCarthy, Minsky, Rochester and Shannon in 1955; This referred to the imitation of human activities by a certain computer system; however, one of the debates that have existed since the concept was proposed is whether or not AI has the ability to exceed the capabilities of human beings, which calls into question this first approach. Another definition considers AI to be "the ability of a system to interpret external data, learn from it, and use it flexibly to achieve a specific goal" (Kaplan and Haenelin, 2018: 3).

Thus, according to these definitions, artificial intelligence can be conceptualized in the context of marketing as a technology capable of learning to feel, learn, analyze, act and solve problems with equal or greater capacity than that of a human. Consequently, it's important to ask whether artificial intelligence can replace human expertise to generate valuable marketing insights and trigger actions by learning from what it's doing. Norbert Wirth (2018), says that this is already happening in areas such as online targeting. It's no wonder we see these solutions growing rapidly in the digital ecosystem because these decisions are made at such scale and speed that a human would simply be lost. Nowadays the definitions that can be found on the internet or in dictionaries about AI focus on what is a science or technology based on the computing and computerization of machines or

robots, which follow algorithms to imitate human intelligence. As an example, we point out the definition proposed by the Oxford Living Dictionary that defines Artificial Intelligence as "The theory and development of computer systems capable of performing tasks that normally require human intelligence, such as visual perception, speech recognition, decision making and translation between languages".

In short, Artificial Intelligence is a science not yet completely defined, as well as new and changing, based on the ability that machines can have to imitate and reflect human actions and behaviors, obtaining from them their own "intelligence" to carry out these actions. This intelligence has to be fed constantly, since being a very variable technology, it needs to learn and renew itself constantly. According to Borges (2019), AI is based on calculation processes such as Big Data, which consists of a base that manages to have enormous amounts of data for processing, Data Models, which are structures to process, select and analyze in an intelligent way the data received, and Processing Power, which is the operational and logistical capability for processing information quickly and efficiently.

### **Where do chatbots come from? The historical evolution of chatbots**

Alan Turing, considered the father and pioneer of AI, achieved that today it has gone so far thanks to his theories and discoveries, being today a reference in history and practice. Thanks to its contribution to human knowledge, the development of technology has grown to the point that machines are able to work on their own, being able to be "intelligent" indeed. AI, and specifically Chat Bots, were developed in the wake of his 1950 paper "Computer Machine and Intelligence," in which Turing began by asking a question: "Can machines think?" From this question came "**The Imitation Game**": The game consisted of the participation of three people: A man (A), a woman (B) and an interrogator (C). The interrogator is in a separate room and his role is to guess who is the man and who is the woman. "A" will try to trick you into thinking it's "B," and "B" will help you. The purpose of this game was to change to "A" for a machine and see if the interrogator was able to differentiate the person from the machine. This game is known as the "Turing Test", whose objective was to see if a machine could be considered intelligent or not (Turing, 1950).

Since then, the Turing Test has been considered the precursor of the creation of the commonly called "Chatbots" today. This test has been used for decades to examine the ability of these chatbots to use AI and maintain a conversation as human and real as possible and thus not be able to be distinguished as machines. It was not until 2014 that a Chatbot passed this test. The idea of what is known today as a "Chatbot" was born at the Massachusetts Institute of Technology (MIT), where many other related projects also emerged. Turing's work inspired many other researchers on the subject, such as the German computer scientist Joseph Weizenbaum, belonging to MIT, who created what is considered today the first Chatbot, ELIZA, in 1966. Weizenbaum (1966) defined it as "a program that makes natural language conversation possible with a computer". Its aim was to "demonstrate that communication between man and machine is superficial".

The operation of ELIZA was based on the recognition of keywords associated with an internal record. She acted as a psychotherapist, with the aim of following guidelines based on these keywords, so that it seems that she is listening to the interlocutor. This chatbot responded in relation to the messages proposed by the user using their own words

in the form of a question. When some word did not enter his register, he tried to resume the conversation with a generic response (Weizenbaum, 1966).

The five fundamental technical problems that ELIZA had, according to Weizenbaum (1966) were: "The identification of key words, the discovery of a minimal context, the choice of appropriate transformations, the generation of adequate responses or the ability to react to the absence of critical words." In January 1973, computer pioneer Vint Cerf decided to have the two famous chatbots, ELIZA and PARRY, establish a conversation using ARPANET, as a demonstration of their "intelligence" at the International Conference on Informatics (Garber, 2014). The creation of these two chatbots was a remarkable fact in history, which drove the creation and growth of Chatbots until today. In 1988 the term Artificial Intelligence is used for the first time in the domain of Chatbots with the construction of Jabberwacky in 1988, by the programmer Rollo Carpenter (Artificial Solutions, 2020). In 1989 Chatterbot appears, a virtual player of the video game TINYMUD capable of having conversations through chat with the rest of the real players of the game, answer their questions, explore the worlds, etc. This bot gained a lot of fame in TINYMUD, because many players assumed that it was also a real person playing (Mauldin, 1994).

Due to the rise of chatbots and the progression of conversational compounds, in 1990 the Loebner Prize for Hugh Loebner was established, which consists of using the Turing Test format where judges have conversations with Chatbots in order to check which chatbot most resembles a human (Artificial Solutions, 2020). In 1991 Dr. Sbaitso was created, a Chatbot whose role is "psychologist". This bot differed from the others in the ability to use AI a digital voice to communicate with users (Artificial Solutions, 2020).

In 1995 Richard Wallace developed "Artificial Linguistic Internet Computer Entity" (**A.L.I.C.E.**), inspired by the ELIZA Chatbot. ALICE is a Chatbot that makes use of the NPL, and in addition to the Artificial Intelligence Mark-up Language (AIML), so it became a much more advanced agent than its predecessor, gaining much success, in addition to the Loebner prize in the years 2000, 2001 and 2004 (Abushawar et al. 2015). In 1997 Clippy was born by Microsoft. It was the first Windows chatbot, whose objective was to provide help to users using the Microsoft Office tool (Watters, 2016). During the new century, new technologies and the use of Artificial Intelligence grew, so it also affected the growth and development of Chatbots.

In 2001, Smarterchild was born, a chatbot found on MSN and AOL instant messaging networks, and provided information on movie schedules, sports scores, stock prices, news and the time it obtained from the databases to which it had access. This represented a significant advance in human-robot interaction and the intelligence that the latter could acquire (Shawar et al., 2007). In 2005 was born what is known as the successor of ALICE, Mitsuku, created by Steve Worswick from AIML technology and winner of the Loebner Prize in 2013, 2016, 2017, 2018 and 2019 (Artificial Solutions, 2020).

Chatbots had a new boom after their development in what is known as personal virtual assistants of intelligent voice, incorporated into mobile devices, computers and smart speakers. This type of Chatbot, also known as Voicebot, has contact with the user through the use of voice, taking care of tasks such as monitoring automatic home devices, calendars and personal emails, facilitated searches, etc. The most famous are: Apple's Siri, IBM Watson, Google Assistant, Microsoft's Cortana, and Amazon's Alexa (Adamopoulou et al. 2020).

**Siri, created in 2008**, is a virtual assistant of a technology company that emerged from SRI International, and was bought by the Apple company in 2011 to use it in its new iPhone 4S mobile device. It makes use of the NLP to answer questions and perform actions within the phone delegated by the user such as phone calls, messages, opening and closing applications etc. (Natale, 2021).

**Watson** was developed in 2011 by IBM with the aim of beating the world champion of the popular contest Jeopardy!. It is a computer system that analyzes questions and content in natural language quickly and concisely. His performance in this program was the beginning of a research task based on decades of experience in Deep Content analysis, NLP, information retrieval (Information Retrieval), Machine Learning and AI (IBM, n.d.).

**Google Now** was developed in 2012 with the aim of providing information taking into account the user's location, the time it was requested and their preferences within the Google Search mobile application. **Google Assistant**, developed in 2016, was its successor. It has a superior Artificial Intelligence, offering information to users predicting their needs. However, it has no personality and its questions may violate the user's privacy, as it is directly linked to its Google account (Adamopoulou et al. 2020).

**Cortana**, developed by Microsoft in 2014 with the ability to recognize voice commands, answer questions, find requested information, send emails and messages, create reminders and the... The same year, Amazon developed **Alexa**, a built-in Voicebot for home automation and entertainment devices (Adamopoulou et al. 2020). Alexa, beyond performing similar actions to its competitors such as making calls, opening applications, sending messages, creating reminders and others, also performs everyday tasks inside the home instead of its user, such as turning on and off the Smart TV, changing the channel, putting and removing music from any device smart, turn lights off and on, electronics, etc. Although this feature is only useful if the house is equipped with smart electronic devices that have this function linked with Alexa.

2016 was a culminating year for the history of chatbots. This year was when Chatbots were developed to be carried out on social media platforms for the promotion and growth of brands. Facebook launched its messaging platform (Facebook Messenger), in which it was introduced the use of bots to interact with users within the social network, managing to become leaders in Chatbot programs and exceeding 300,000 active Chatbots on its platform in 2018 (Artificial Solutions, 2020). In addition, Vicent (2016) relates that in 2016 the famous Tay Chatbot was born, created by Microsoft for the social network Twitter. It is a Chatbot with the ability to learn natural language that simulates being a teenager within the social network to interact with young people. Not even 24 hours have passed since it was launched when the Chatbot began to use racist, xenophobic, sexist behavior. thus publishing tweets against Mexicans, Jews, praising Hitler and Trump, supporting genocide, etc. This is because the Artificial Intelligence of this Chatbot consisted of learning and repeating the tweets that people were sending it, thus acquiring an unfiltered knowledge that caused a great stir and an early closure of the Twitter account of Tay by Microsoft (The Guardian, 2016).

In 2020, after the beginning of COVID-19 pandemic, Chatbots acquired even more prominence, since they have been fundamental sources of information and humanitarian aid necessary due to ignorance of the virus and everything that surrounded it. There have been thousands of Chatbots created all over the world with this objective, either to provide

information about the Coronavirus, its symptoms, clarify the doubts of the pandemic, the state of confinement, denying hoaxes of the disease, etc. These Chatbots have been developed for all kinds of instant messaging applications, such as Facebook Messenger, WhatsApp and Telegram.

### **The main advantages and disadvantages of using chatbots**

The use of Chatbots in companies generates a multitude of benefits, since using these systems for customer service is not only a streamlining and improvement of time and type of response, but also customer satisfaction. Generally, following the article by Zumstein & Hundertmark (2017), the benefits that we can find when implementing a Chatbot in a company are:

Availability of customer service 24 hours a day, 7 days a week, plus a new way of direct customer contact. That is, companies through a Chatbot can contact the customer directly, and this answer the doubts or requests of users, even in non-business hours, quickly and efficiently.

This in turn provides a saving of money for the company, since the use of this assistant makes it require less hiring of personnel for customer service, since the use of a Chatbot requires an investment that is not necessarily high, depending on the type of Chatbot that is lame and the AI that is incorporated.

In addition, you also save with respect to response time to users compared to real agents, which in turn improves customer satisfaction and their user experience.

Chatbots can be incorporated into instant messaging applications, websites, social networks within what is the world of the Internet. In addition, more at the user level, those also known as virtual assistants are also in devices such as Smartphones, smart speakers such as Amazon's Alexa, or even in smart TVs or Smart TVs. So anyone with a smart device can make use of this technology and experience all its benefits.

On the other hand, following the previous article, Chatbots make it possible for the company to have access to the personal data of customers with whom conversations have been established, such as their profiles, interests and tastes. This data is stored in order to use it to improve the marketing of the company, which provides the opportunity to create highly personalized offers for those customers.

The literature also indicates chatbots' disadvantages. In their article "*Adaptive Behavior of Context-Dependent Chatbots*", Rodríguez, Merlino, & Fernández (2014) explain the main problems in the interpretation of the ways in which the context is related to the content of the conversation with a chatbot, emphasizing several disadvantages of chatbots, such as: resolution of referents; lexical ambiguity; ellipsis in linguistics; limitation of the answers to closed questions; Rigidity; Robotic tone; Impersonality.

However, according to the literature presented above we can conclude that chatbots are an **innovative tool** for today's businesses. The fact that the company uses one, either on its website or from a messaging application, makes it acquire more prestige, improving the image of the company's brand.

## **Conclusions**

At this point we will recapitulate everything developed throughout the work and synthesize the main contributions made to demonstrate compliance with the objectives.

The first goal we set was to understand what a bot is, how they can be classified and how they work. With the information provided, we can conclude that bots are computer programs operating on the Internet, which are trained by a set of rules to act autonomously and offer a service. The truly important technological advances are those that are capable of changing the world. More than five thousand years ago the human being made one of the most important inventions of all time, without a doubt the wheel was a before and after in the history of humanity, the invention of computers marked the beginning of the current era, machines that automatically are able to perform in just seconds calculations that would take humans years. Just a couple of centuries ago to think of something like that was total madness, today it is something so common that it is impossible to conceive life without electronic devices.

The second objective was to analyze in detail the specific case of chatbots and know their characteristics. Today there are many people who think that the intelligence of computers will never be the intelligence of human beings, today the idea that a machine thinks for itself is crazy, but little by little it ceases to be so, for a technological advance to be carried out only a mind with the ability to imagine is necessary. To put it into reality, with such large companies making such big advances in the field of artificial intelligence, it's only a matter of time before machines think for themselves.

One of the biggest failures that artificial intelligence has is its way of communicating with human beings, it is easy to notice when you are talking to a machine and because of this we instinctively lose the ability to judge it objectively, human beings have always been characterized by fear of the unknown, by rejecting what they do not understand, and therefore the changes must be made in a more transparent way that they are noticed as little as possible, as in the invention of the touch screen, at first many thought it was a bad idea for the fact of leaving the buttons, but companies like Apple with their devices made the change in such a transparent way that it is something accepted worldwide.

The human being prefers what resembles him, that is why our project focuses on making the machine communicate more closely to the human being, that the difficulty to differentiate if you talk to a machine or a human is greater, is a way to globalize the use of artificial intelligence for more "Human" tasks. More sociative, artificial intelligence is widespread but for the most part it is only used for projects that the end user does not see, such as YouTube with its selection of recommended videos, but in other areas it is difficult to take this technology seriously, companies such as IBM have made efforts and advances worthy of study such as their artificial intelligence Watson, the largest technology companies know that the future of technology is in artificial intelligence, so projects like Cortana in Microsoft, or Siri in Apple, these virtual assistants have a gap in the market but do not go beyond the basic functions, and although their way of expressing themselves is already more similar to the natural language of human beings, They remain far from achieving a fluid conversation.

These technologies that interact directly with humans are called Chatbot; Chatbots in their most widespread meaning are a Bot with the ability to communicate with humans

either in writing or by voice, when the chatbot can understand the human voice, it is also called a voice assistant.

In 2020, after the beginning of COVID-19 pandemic, Chatbots acquired even more prominence, since they have been fundamental sources of information and humanitarian aid necessary due to ignorance of the virus and everything that surrounded it. There have been thousands of Chatbots created all over the world with this objective, either to provide information about the Coronavirus, its symptoms, clarify the doubts of the pandemic, the state of confinement, denying hoaxes of the disease, etc. These Chatbots have been developed for all kinds of instant messaging applications, such as Facebook Messenger, WhatsApp and Telegram.

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